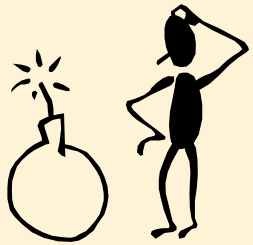
CLCS Production Console Enclosure Design Panel 3

December 11th, 1997

1pm - 3pm

LCC 3R23

Presenters:



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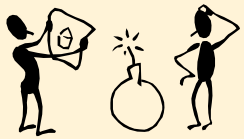
Introduction

This Design Panel will cover the following topics:

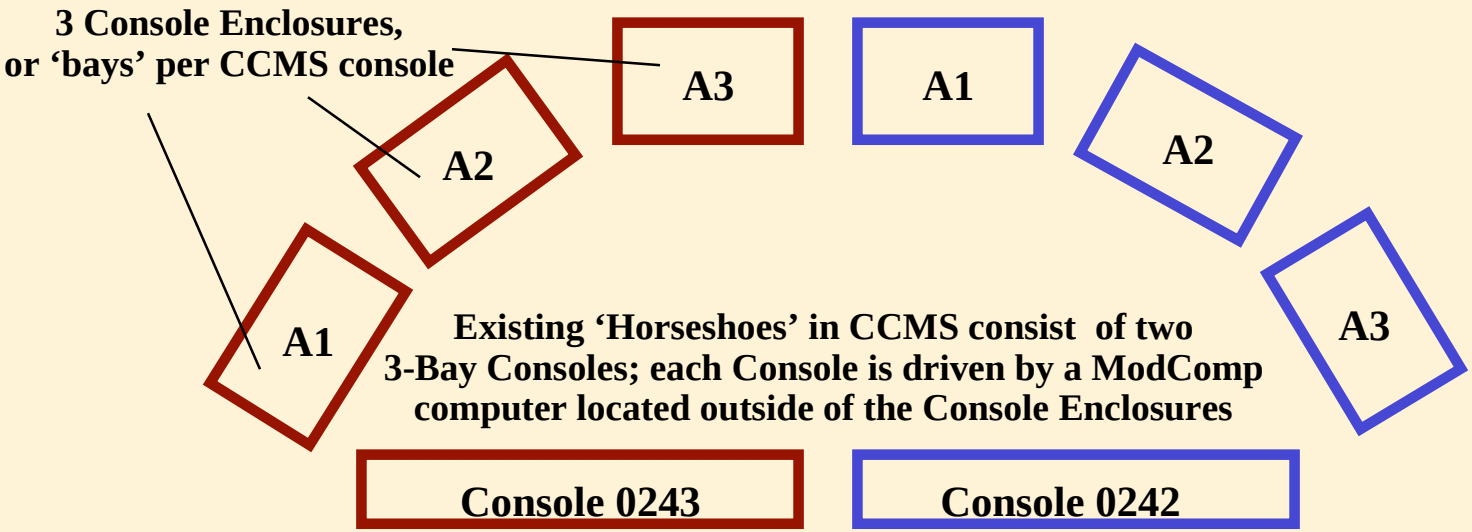
- **The current view of the role and functionality of the various types of Console Positions in CLCS control rooms**
- **Feedback generated from user evaluation of LCC-X Prototype consoles**
- **Outstanding Issues concerning CLCS Production Console Enclosures, including issues resolved since the Internal DP3 on December 3rd**
- **The current specification (requirements listing) to be used for the prototype Console Enclosures**
- **Acquisition strategy and schedule for the Production Console Enclosures**



Presentation Outline

High-Level Console Concept

CCMS 'Multi-bay Consoles' will be replaced by CLCS 'Console Positions'



In CLCS, such an arrangement would be considered <u>SIX Console Positions</u>; each position will have its own command and control workstation

High-Level Console Concept (continued)

New features of CLCS Console Positions

- **Graphical User Interface (GUI) workstations using "windowing" to allow for increased efficiency in the displaying of data**
- **BIN Workstations for monitoring data, for accessing online documentation and for bringing office productivity tools into the Control rooms**
- **Flexibility with Console Position hardware (including the safing system) to allow CLCS users to support testing operations from any Console Position**
- **Connectivity to center-wide and world-wide information systems**

High-Level Console Concept (continued)

CLCS sets will contain five types of Console Enclosures:

- **System Engineering Console Enclosure**
- **Test Conductor Console Enclosure**
- **Console Support Module Enclosure**
- **Mission Management Console Enclosure**
- **Peripheral Housing Enclosure**

NOTE: The role of a unique 'Back Room Console Enclosure' would be better served by System Engineering Console Enclosures and by Console Support Modules

Each type of Console Enclosure fulfills a unique role and contains distinct functionality requirements for CLCS

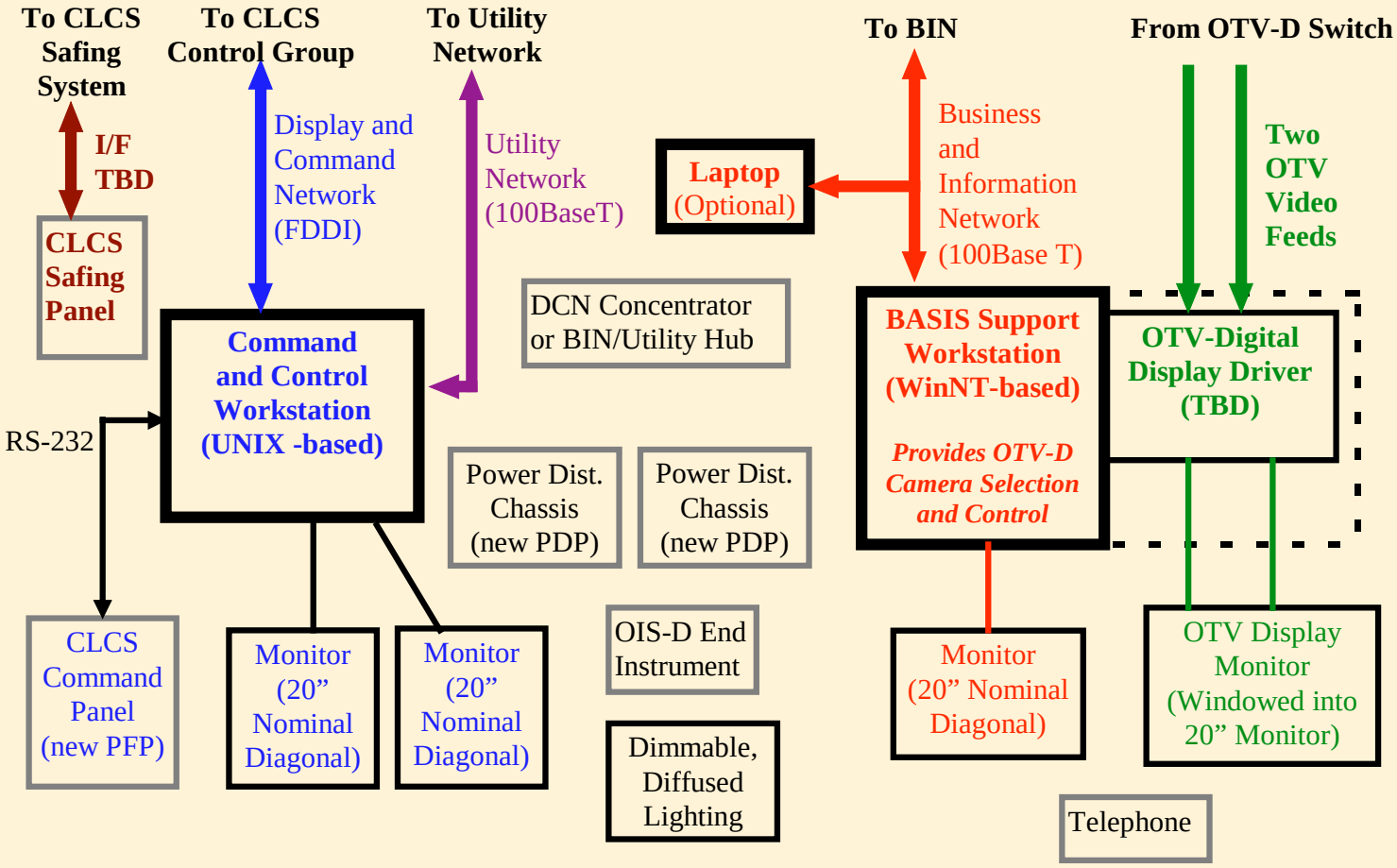
High-Level Console Concept (continued)

Role of the System Engineering (SE) Console Position

(Intended for Use in ALL CLCS Sets)

- Provides ability to initiate application programs to command and control flight hardware and associated ground support equipment
- Allows CLCS users to invoke “hardware safing” in order to safely recover from fatal faults and loss-of-data conditions
- Provides access to online documentation, e-mail, office productivity and remote information systems
- Allows users of the new Operational Television system to view, select and control cameras
- Contains voice communication equipment required to support testing operations
- Allows CLCS Users to perform realistic OMI training in the Integrated Development Environments (IDEs)
- Can be comfortably operated by a single user or a pair of users

High-Level Console Concept (continued)



CLCS System Engineering Console Position Functional Connectivity as of December 4, 1997

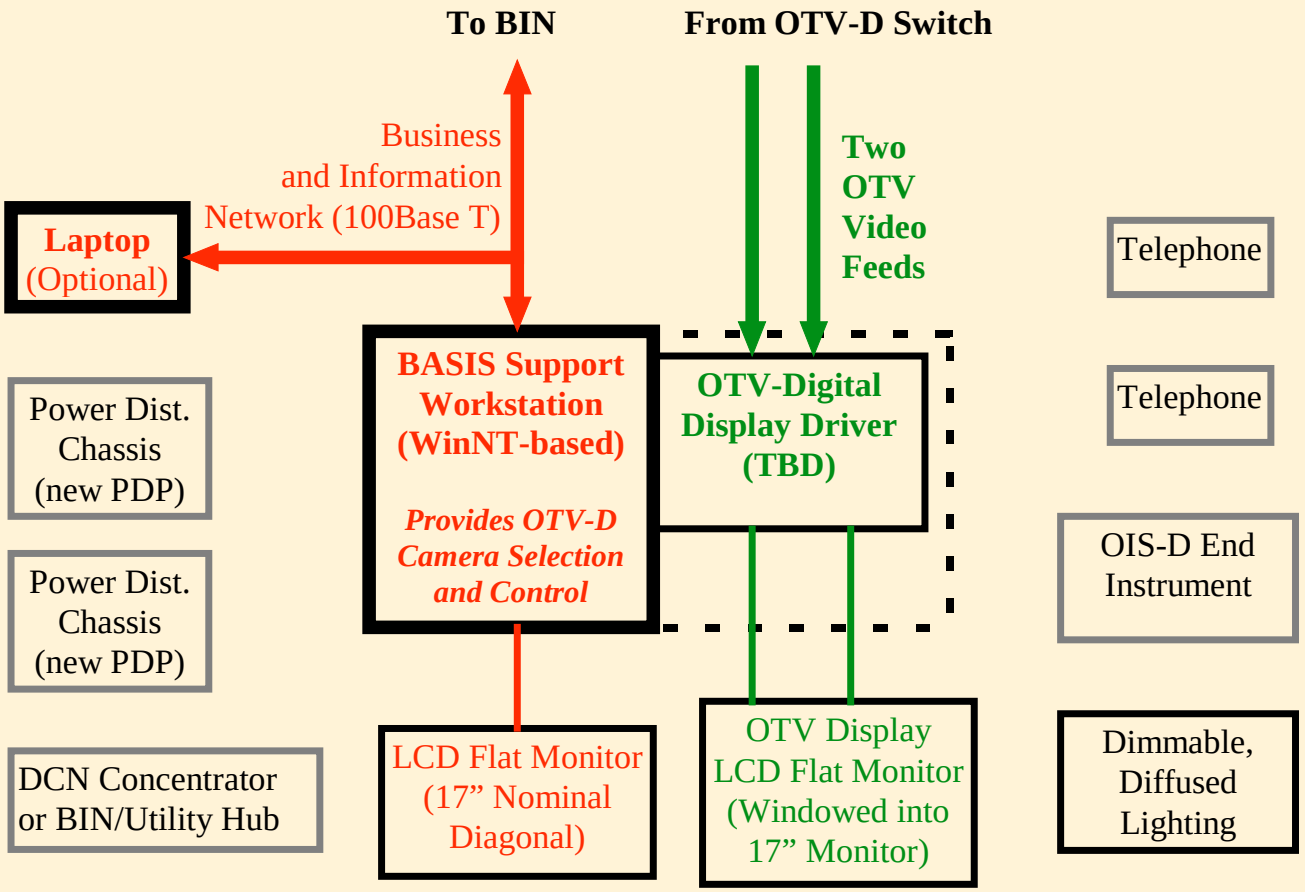
High-Level Console Concept (continued)

Role of the Test Conductor (TC) Console Position

(Intended for Use in the OCR-1/2/3, CITE, DRFC, LCC-X and CCS CLCS Sets)

- **Provides access to online documentation, e-mail, office productivity and remote information systems**
- **Allows users of the new Operational Television system to view, select and control cameras**
- **Contains voice communication equipment required to support testing operations**
- **Operated by a single Test Conductor**

High-Level Console Concept (continued)



CLCS Test Conductor Console Position Functional Connectivity as of December 4, 1997

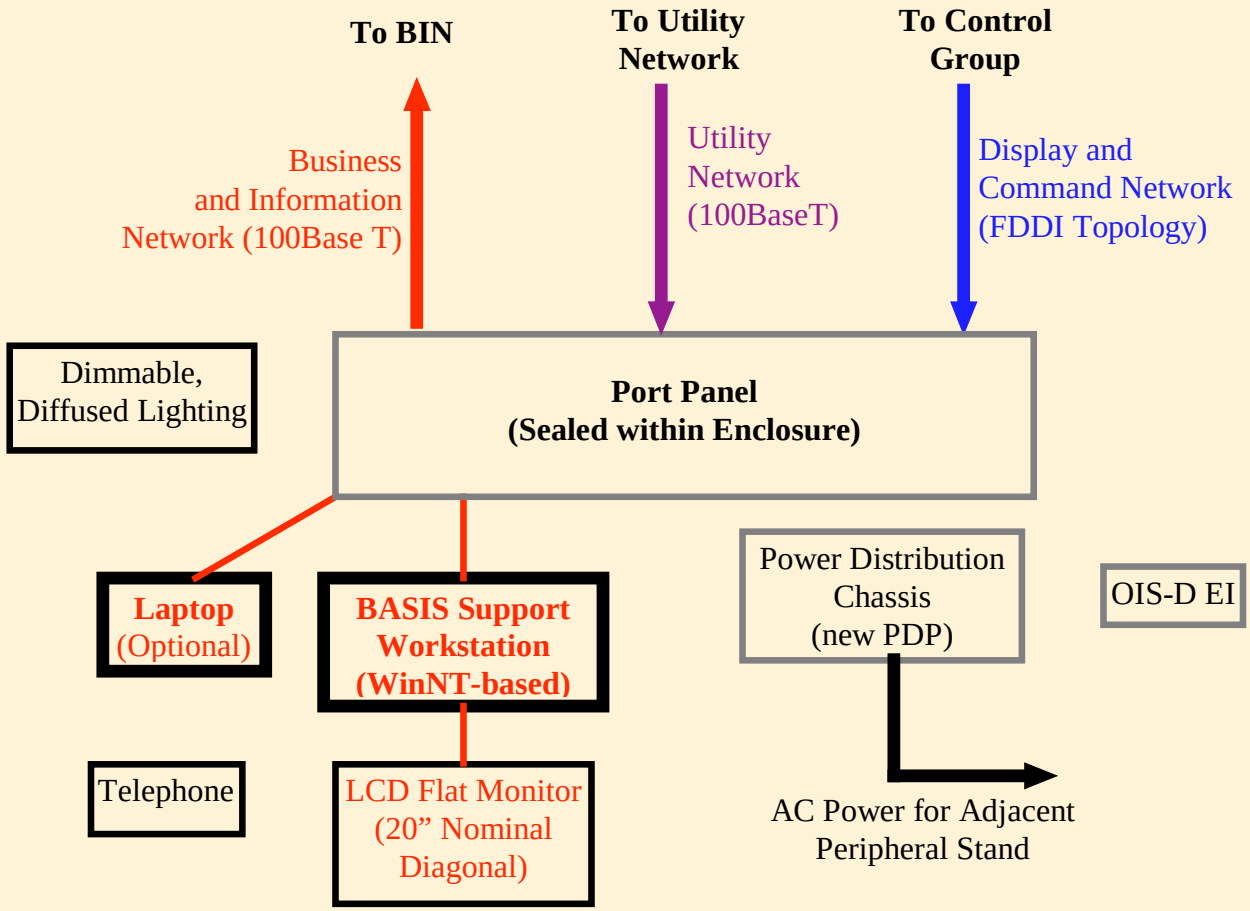
High-Level Console Concept (continued)

Role of the Console Support Module

(Intended for Use in the OCR-1/2/3, SAIL, HMF, CITE, DRFC, IDE1/2, LCC-X and CCS CLCS Sets)

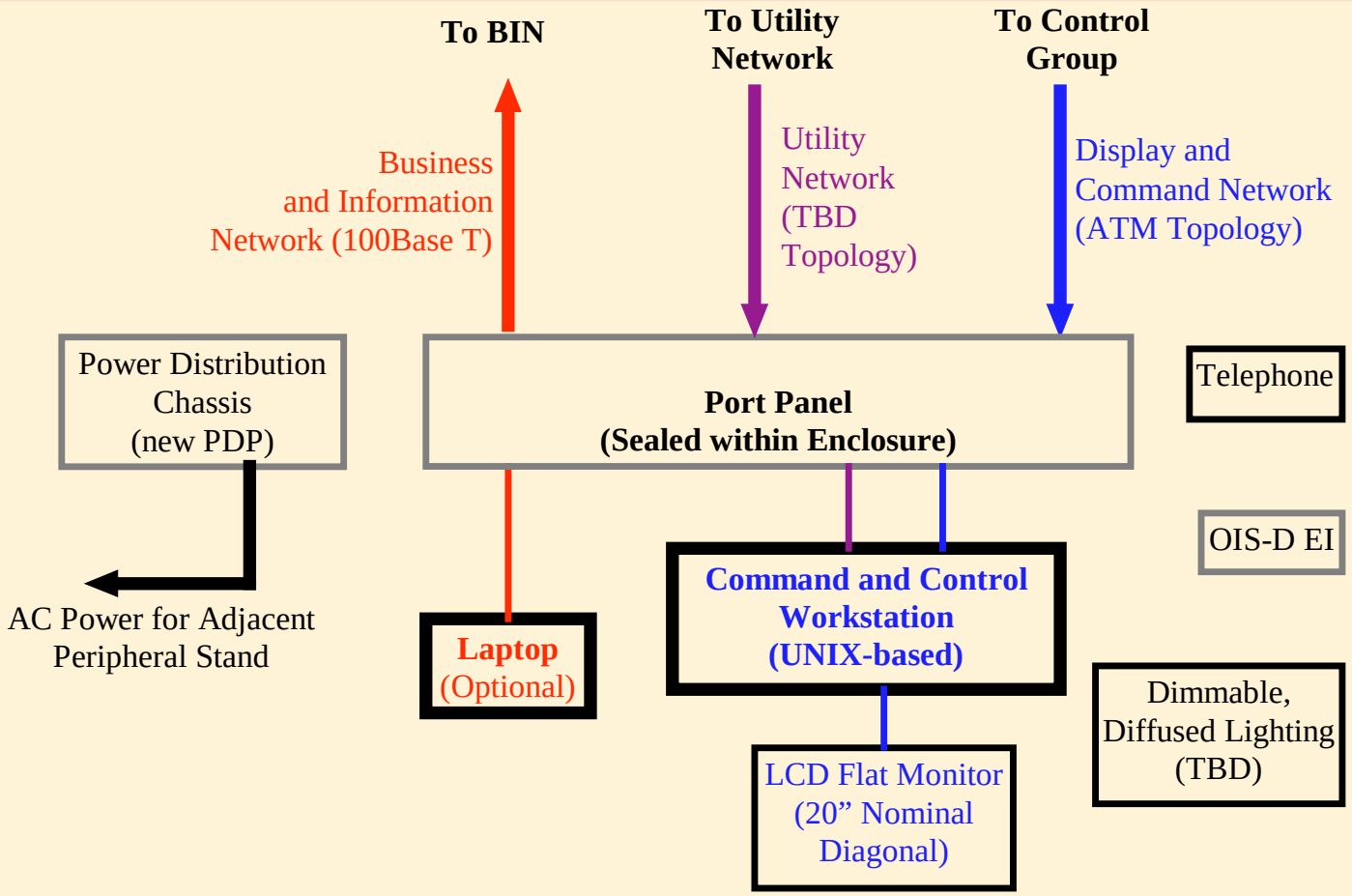
- **Allows, as a configurable option, CLCS Test Conductors the ability to "assign" SE Console Positions to specific users for testing operations**
- **Allows, as a configurable option, limited ability to initiate application programs to command and control flight hardware and associated ground support equipment**
- **Provides access to online documentation, e-mail, office productivity and remote information systems**
- **Contains voice communication equipment required to support testing operations**
- **Allows CLCS Users to perform realistic OMI training in the Integrated Development Environments (IDEs)**
- **Can be comfortably operated by a single user or a pair of users**

High-Level Console Concept (continued)



CLCS Console Support Module Functional Connectivity - Configuration 'A'
as of December 4, 1997

High-Level Console Concept (continued)



CLCS Console Support Module Functional Connectivity - Configuration 'B'
as of December 4, 1997

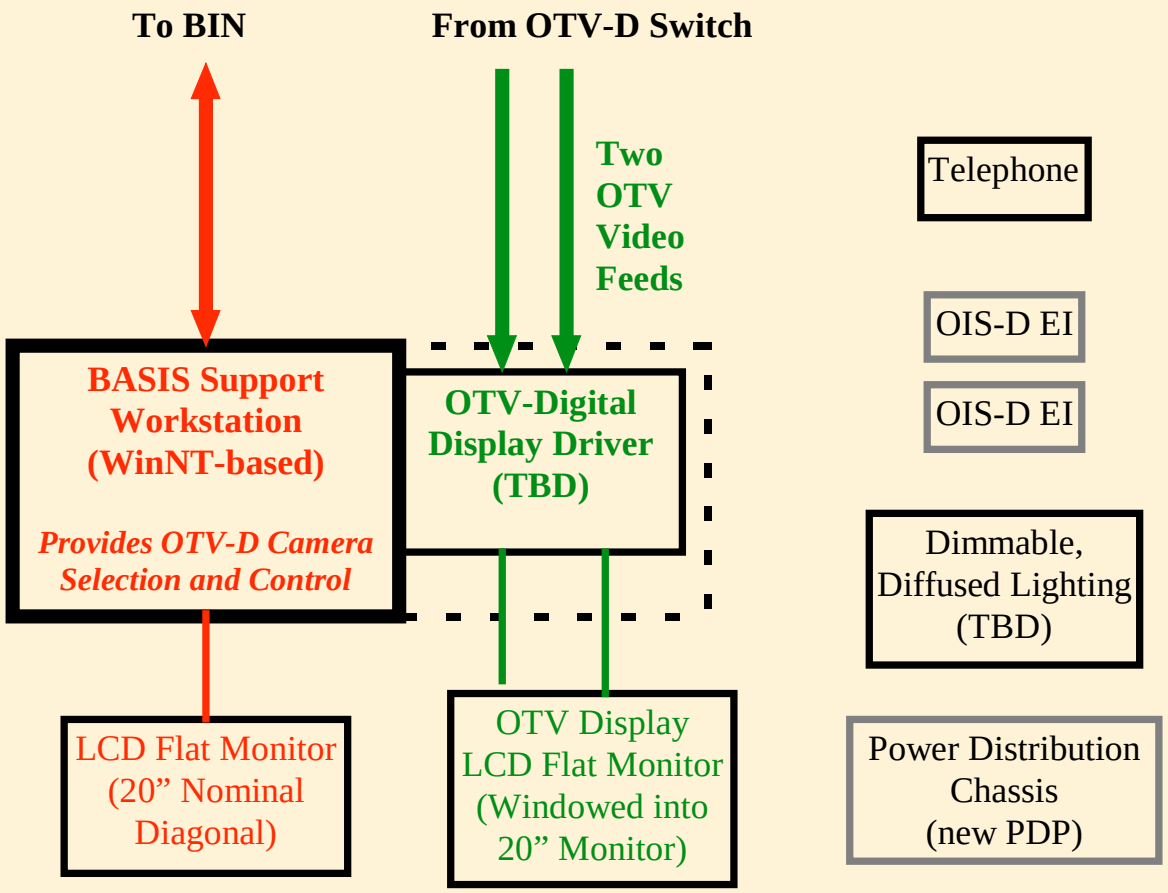
High-Level Console Concept (continued)

Role of the Mission Management Console

(Intended for Use in the OCR-1/2/3 and LCC-X CLCS Sets)

- **Allows users of the new Operational Television system to view, select and control cameras**
- **Provides access to online documentation, e-mail, office productivity and remote information systems**
- **Contains voice communication equipment required to support testing operations**
- **Can be comfortably operated by a single user or a pair of users**

High-Level Console Concept (continued)

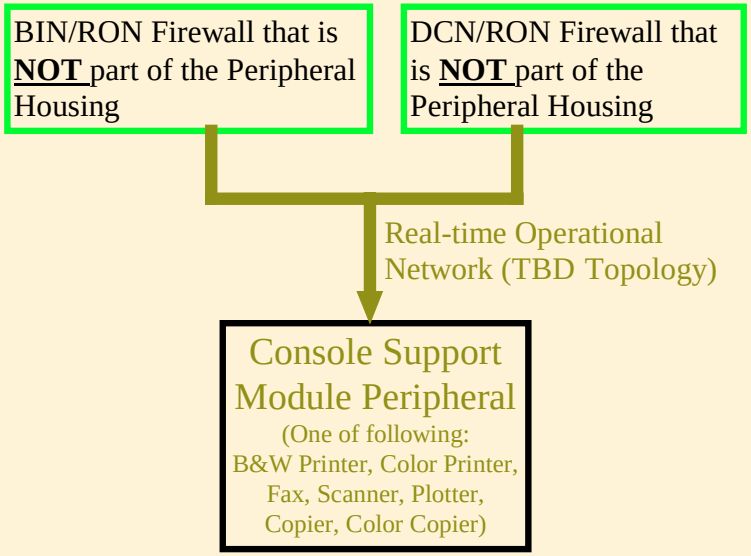


CLCS Mission Management Console Position Functional Connectivity as of December 4, 1997

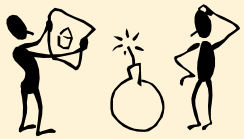
Role of the Peripheral Housing

(Intended for Use in ALL CLCS Sets)

Contains peripheral (printer/fax/plotter/scanner) accessible to Console Positions within a CLCS Set



CLCS Peripheral Housing Functional Connectivity as of December 4, 1997



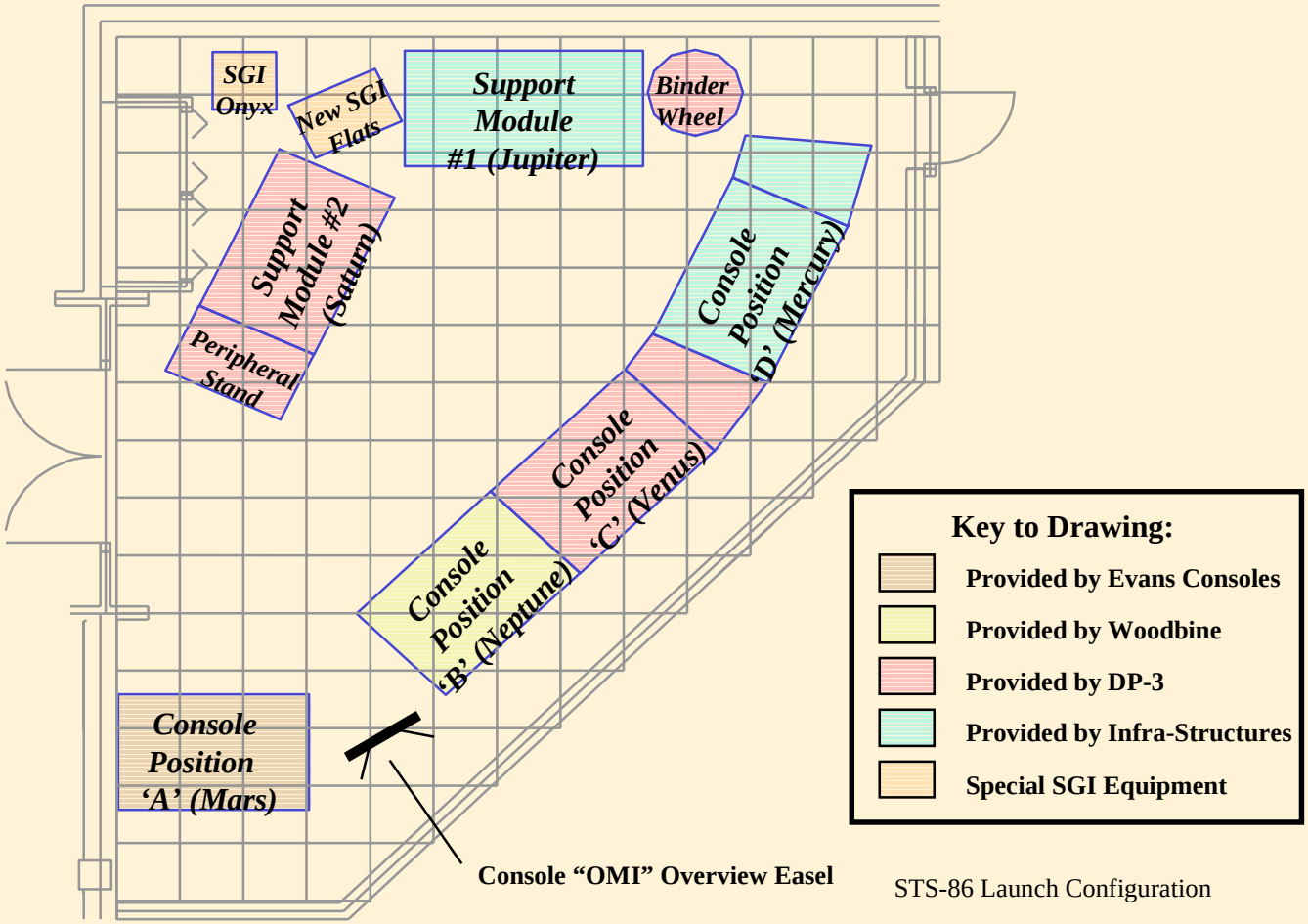
Presentation Outline

LCC-X Evaluation Summary

- **For the CLCS REDSTONE delivery, four different Prototype SE Console Positions were deployed in LCC-X for demonstrations and for user evaluation; three of the four enclosures were provided by commercial vendors, the fourth was built in-house**
- **All four Prototype SE Consoles were loosely based upon a common specification**
- **Over one hundred and fifty evaluation sessions were performed on the four consoles.**
- **An evaluation form was generated and sessions were videotaped to capture ergonomic and functionality feedback from future CLCS users for use in updating the Console Enclosure specification**
- **In addition, the CCMS Maintenance and CLCS Reliability and Maintainability personnel performed a separate evaluation of the four consoles for ease of maintenance; the report of their findings was also used to update the specification**

LCC-X Evaluation Summary (continued)

LCC-X Configuration for REDSTONE Delivery



STS-86 Launch Configuration

LCC-X Evaluation Summary (continued)

Preferred Features of Console Enclosures (to incorporate in final design):

- **The rubber trim and edging of the 'Mars' Console desktop**
- **The 'cockpit' feel of the 'Mars' Console**
- **The convection cooling concept of the 'Mars' and 'Venus' Consoles**
- **The laminate used in the 'Neptune' Console desktop**
- **The bi-level desktop and keyboard storage concept of the 'Venus' Console**
- **The 'angled' monitor concept used in the 'Venus' Console**
- **The rack panels (using the correct color) in the 'Mercury' Console**

LCC-X Evaluation Summary (continued)

Least Preferred Features of Console Enclosures (avoid in final design):

- **The keyboard storage used in the 'Mars' and 'Neptune' Consoles**
- **The laminated "skins" used in the 'Mars' and 'Mercury' Consoles**
- **The 'non-centered' location for legacy equipment used in the 'Mars' Console**
- **Monitor access for maintenance in the 'Mars' and 'Neptune' Consoles**
- **The gooseneck lighting used in the 'Neptune' Console**
- **The OIS-D headset jack mounting used in the 'Venus' Console**
- **The phone mounting concept used in the all of the Consoles**
- **The overall and monitor height of the 'Mercury' Console**
- **The dark, glare shield doors used in the 'Mercury' Console**

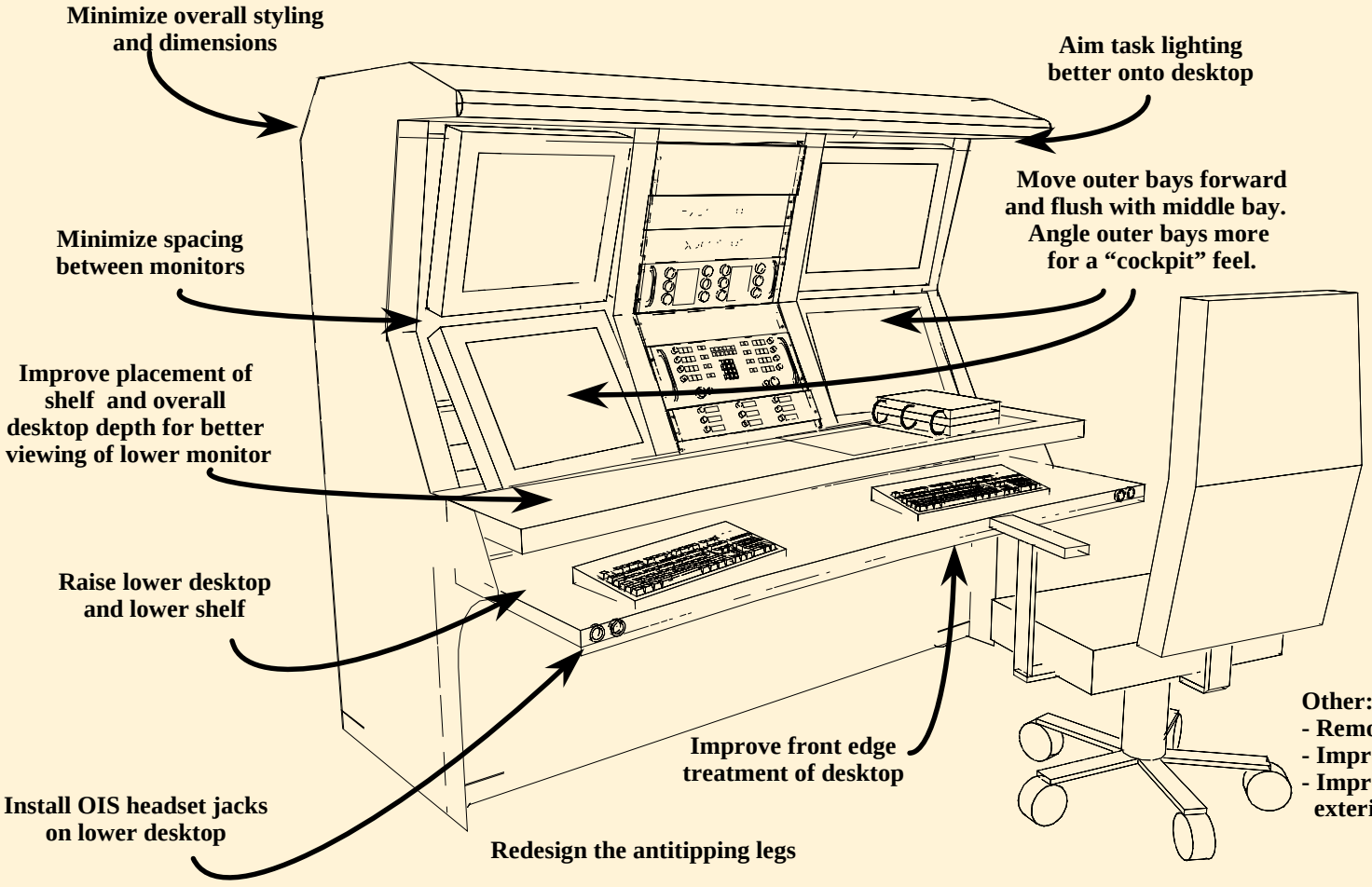
LCC-X Evaluation Summary (continued)

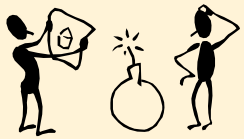
General User Feedback Highlights:

- **Users strongly preferred the LCD Flat Screen Monitors used in the 'Venus' Console to the CRT Monitors used in the other consoles**
- **Users preferred displaying OTV Video in a large monitor as opposed to the legacy OTV implementation used in the 'Mercury' Console**
- **Users felt that a large amount of space on the desktop is important**
- **Many users want the existing CCMS OIS-D headset jack mounting scheme (built into front edge of tabletop) replicated in the CLCS design**
- **Most users wanted easy reach to legacy hardware**

SE Console Enclosure Requirements (continued)

"Venus" Console Enclosure Modifications





Presentation Outline

Console Enclosure Open Issues

‘Minor’ Console Issues (enclosure design can proceed without resolution)

- **Unknown physical dimensions of the Command and Control Workstation, BASIS Support Workstation and CLCS Safing Panel**
- **Unknown “display driver” implementation (including monitor selection) of the OTV Digital system**
- **Unknown “typical usage” scenario for CLCS System Engineering Console**
- **Unresolved requirements with the OMR/OSR portion of the OCR-1 layout (which may affect the requirements of the Mission Management Consoles)**

Console Enclosure Open Issues (continued)

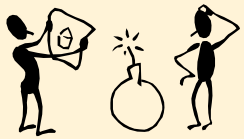
‘Minor’ Console Issues (enclosure design can proceed without resolution)

- **The implementation of ‘Command Panel’ functionality (physical box vs. on-screen)**
- **Final selection of the task chair (to confirm JUNO feedback) should be done via a separate evaluation**
- **Final selection of the telephone to be used in the CLCS control rooms (will mount or place whatever phone it is in console ‘wedges’ and ‘extensions’)**

Console Enclosure Open Issues (continued)

Resolved Console Issues (since the December 3rd Internal Design Panel)

- With some late-breaking information concerning the size of computer CPUs, the maximum CPU height requirement has been revised from 25 inches to 21 inches. This allows for a 'generic' SE Console Enclosure design and allows for the 'monitor orientation' issue to be resolved at a later date.
- Based upon the need for 'high fidelity' OMI training to be performed in the IDE, the unique 'Back Room' Consoles will be deleted and replaced with System Engineering Console Enclosures and Console Support Modules.
- The capability to use a Laptop Computer at a SE Console Position has been added to the specification.
- The CLCS "Port Panel," which allows the ability to connect to the DCN and issue critical commands, will be hidden inside the Console Enclosure.



Presentation Outline

Console Position Enclosure Requirements

Drivers for Console Position Footprint

- **72” x 48” - System Engineering Console Position**
- **42” x 48” - Test Conductor Console Position**
- **72” x 36” - Console Support Module**
- **42” x 36” - Peripheral Housing**

- **Limited space in OCRs**
- **OCR Facility modification costs**
- **Large number of Console Positions in OCR1/OCR2**
  - **36 System Engineering Consoles**
  - **17 Test Conductor Consoles**
  - **18 each Mission Management Consoles, Console Support Modules and Peripheral Housings**

Console Position Enclosure Requirements (continued)

Console Design Challenges

- **Fit everything within arms reach for "pilot," yet be accessible to "co-pilot" when sharing**
- **Flexibility for configuration changes (i.e., facility floor plan, different subsystem layouts, more processors, more monitors, more rack equipment, laptops, etc.)**
- **Cable management on desktop (OIS-D headsets, 2 keyboards, 2 or 3 mice, laptops, etc.)**
- **Various user preferences: "keyboardists" versus "point-and-clickers"**
- **Rack-mount capability**

"Common" Console Enclosure Requirements

BASIC REQUIREMENTS

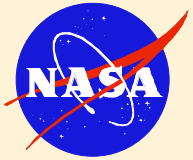
1) Design for useful life of 20 years
2) Base design on thorough study of Human Factors Engineering considerations
3) Like assemblies, subassemblies, and replaceable parts shall be mechanically interchangeable, regardless of the manufacturer or supplier
4) Furniture shall be designed to sustain accidental punishment and predictable excessive weight (electronic equipment, personnel, books, etc.)
5) External surfaces shall be cleanable, resistant to mild abrasion, and not be subject to damage by common liquid spills or cleaning agents.

"Common" Console Enclosure Requirements

BASIC REQUIREMENTS (continued)

6) **Protect internally mounted electronics against spilled liquids.**

7) **Enclosure design shall not preclude the ability to modify the enclosure to house CRT monitors of comparable screen size in each monitor location, if required**



"Common" Console Enclosure Requirements (continued)

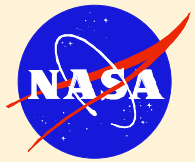
QUALITY REQUIREMENTS

1) Workmanship in accordance with good commercial practices
2) Commercially produced CLCS Enclosures shall be subjected to a receiving inspection at KSC to determine compliance with the specifications

"Common" Console Enclosure Requirements (continued)

SAFETY REQUIREMENTS

1) Maximum safety and convenience for installation, operations, and maintenance personnel
2) Be devoid of sharp edges, holes, corners, exterior protrusions
3) Minimize tripping, pinching, and other similar safety hazards
4) Be designed so that assemblies and components do not create a fire hazard during servicing, usage, or storage
5) Provide mounting provisions to facilitate handling and prevents damage to components and injury to personnel
6) Desktop front edge treatment to prevent damage or injury due to incidental contact with personnel, task chairs, or roll-around carts



"Common" Console Enclosure Requirements (continued)

ARCHITECTURAL REQUIREMENTS

1) Style shall present an aesthetic, professional appearance for public and official visibility
2) Surface finish to minimize glare and reflections
3) Surface texture treatment to be maintainable
4) Finish coatings:
   - Primary exterior color: Medium to dark gray
   - Accent color: Deep teal
   - Color of visible surfaces of rack panels: Medium gray
   - Table surface color: TBD
   - Sound absorption fabric color: Chinchilla (light gray)
5) Area(s) for tags (Ref-Des plate, Government property tag, ID tag, etc..)

"Common" Console Enclosure Requirements (continued)

ARCHITECTURAL REQUIREMENTS (continued)

6) Storage for keyboards, pointing devices, and consumables (light bulbs, paper reams, toner cartridges, etc.)

7) OIS Headset Jack Mountings
   - Located at or just underneath the front edge of each end of the desktop
   - Provide for easy installation of the OIS-D headset connector
   - Two connectors per mounting location

8) Bi-level desktop design

"Common" Console Enclosure Requirements (continued)

STRUCTURAL REQUIREMENTS

1) **Durable Materials:**
   - **Structural framework: steel and/or aluminum**
   - **Exterior materials: finished aluminum and/or high-quality laminates**
2) **Transportability:**
   - **Capability for partial disassembly for transport in standard freight elevators and through doorways**
   - **Casters**
3) **Structural support shall not interfere with the operator nor the placement of equipment within the enclosure**
4) **Access openings shall permit full/partial body access and room for tools and component passage**

"Common" Console Enclosure Requirements (continued)

STRUCTURAL REQUIREMENTS (continued)

5) Weight distribution:
   - Anti-tipping features
   - Accommodates changes in centers of mass of the enclosure and electronic components during installation/servicing activities
   - Maximum distributed weight of loaded enclosure: 100 lbs/ft^2 (490 kg/m^2)
   - Desktop load capacity: 55 lbs/ft^2 (270 kg/m^2)
   - Internal shelving load capacity: 75 lbs (34 kg)
6) External panels/doors:
   - Removable/opens without tools, aided by handles/grasp features
   - Self-supporting when open, if not removable
7) Internal shelving: retractable and vertically adjustable
8) Capability of adding standard, 19-inch rack mounting rails to all bays

"Common" Console Enclosure Requirements (continued)

MECHANICAL REQUIREMENTS

1) Metals to be non-corrosive or suitably treated to resist corrosion
2) Avoid dissimilar metals
3) Surface finish coating system TBD (e.g., Powder-Coat, Urethane, Acrylic Enamel)
4) Ventilation
   - Sufficient vent openings for convection cooling of internal equipment
   - Air filters for vent openings, if deemed appropriate
   - Ventilated/perforated shelving (internal to console)

"Common" Console Enclosure Requirements (continued)

ELECTRICAL REQUIREMENTS

1) Power Receptacle Strips

- Judiciously placed throughout enclosure
- Secured to enclosure frame
- Minimum of 4 standard 15A receptacles per strip
- Ability to accommodate all common types of plug housings (e.g., computer transformer plug, etc.) with appropriate clearance
- One strip per "bay," unless otherwise specified

2) Utility Panel

- AC power receptacles
- Network ports for laptop capability
- Dimmer switch for task lighting
- Headphone jack to BIN speakers
- Telephone jack

"Common" Console Enclosure Requirements (continued)

ELECTRICAL REQUIREMENTS (continued)

3) Appropriate grounding provisions

4) Task Lighting
   - Dimmable and diffused
   - Illuminates work surface, placard holder, inside console for servicing
   - Easily accessible for servicing

5) Cable Management
   - Grommet holes for cable routing
   - Facilitate proper alignment and routing of and access to all connectors and cables
   - Means of running cabling to adjacent enclosures
   - Capture hardware for incoming wires/cables from raised floor

"Common" Console Enclosure Requirements (continued)

INSTALLATION AND SERVICING REQUIREMENTS

1) Minimize number of tools needed
2) Minimize number of technicians (preferably one) required to accomplish majority of relevant installation and servicing tasks
3) Provide means to match horizontal surfaces of adjacent enclosures due to uneven flooring
4) Make routine alignment/adjustment points easily accessible
5) Monitors should be removable from the front of the console

SE Console Enclosure Requirements

Conceptual Sketch

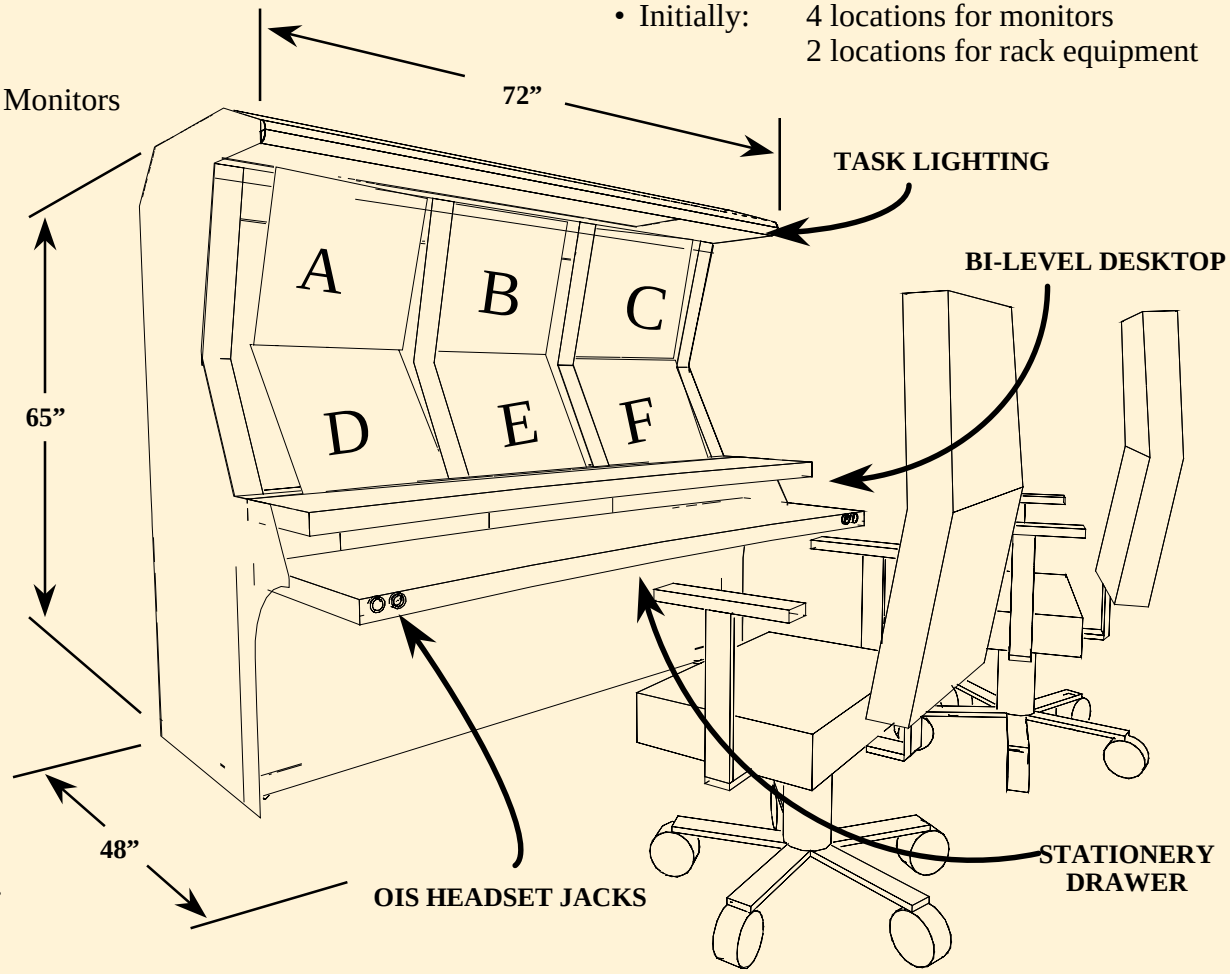
Workstations:
- Command & Control CPU with two Monitors
- BIN CPU with one Monitor
- OTV Monitor
- BIN/OTV CPU, if required

Visible Rack Equipment:
- OIS 51-D Unit
- Command Panel
- Safing Panel
- Utility Panel
- Expansion Area/Venting

Hidden Rack Equipment:
- 2 Power Distribution Chassis
- Vivaldi (OTV) Unit
- Network Hub/Concentrator
- CLCS Port Panel
- Expansion Area/Venting

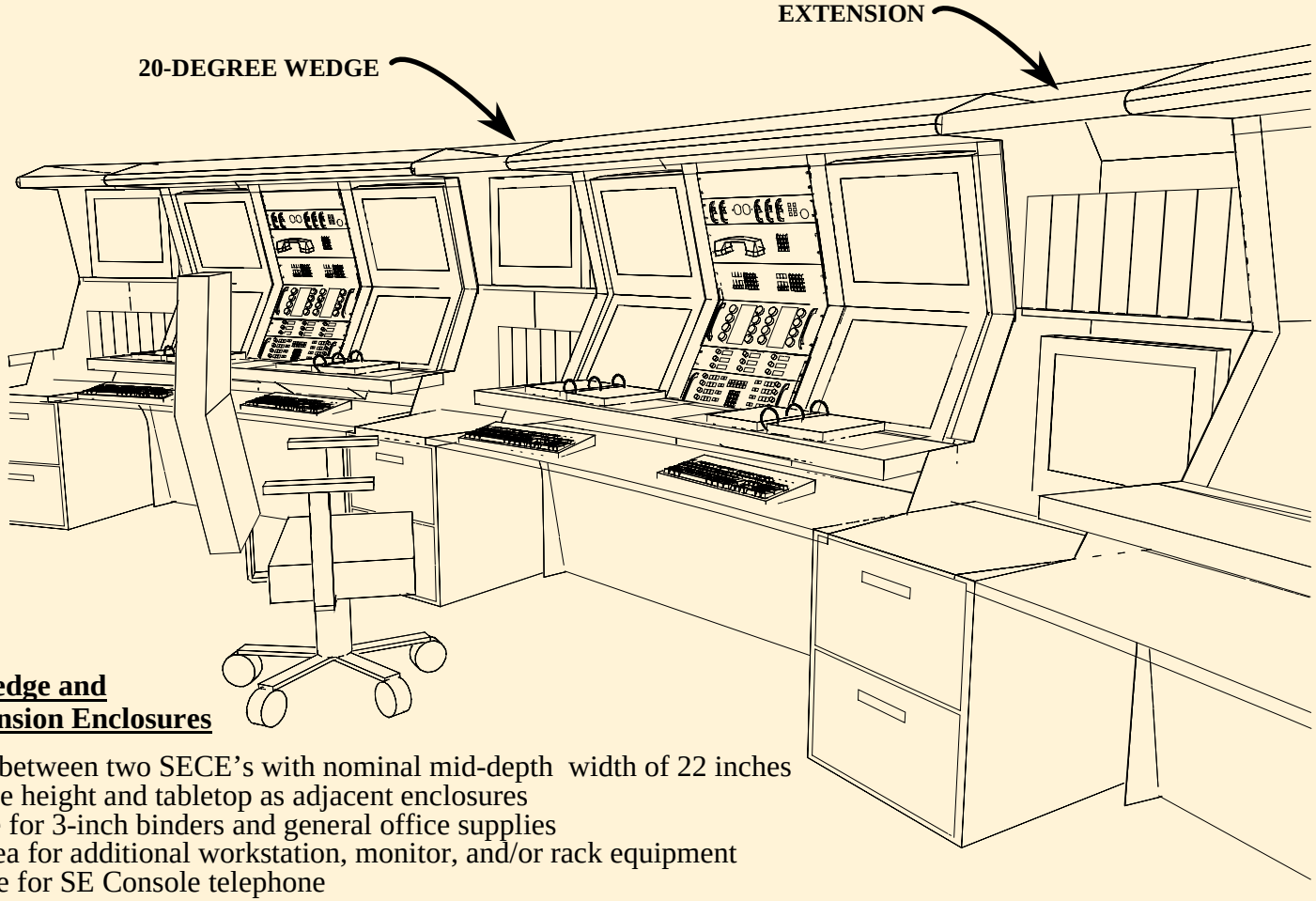
Other:
- 3 Internal Power Receptacle Strips
- 1 Telephone
- Placard Holder
- Primary desktop height: 26” min.
- Primary desktop depth: 22” max.
- Secondary desktop height: 31” max.
- Secondary desktop depth: 13” max.

Layout:
- Six possible locations for monitors: A through F
- Initially: 4 locations for monitors
  2 locations for rack equipment



SE Console Enclosure Requirements (continued)

SE Console Grouping Conceptual Sketch



20-Degree Wedge and Straight Extension Enclosures

- To be placed between two SECE's with nominal mid-depth width of 22 inches
- Maintain same height and tabletop as adjacent enclosures
- Storage space for 3-inch binders and general office supplies
- Expansion area for additional workstation, monitor, and/or rack equipment
- Desktop space for SE Console telephone

TC Console Enclosure Requirements

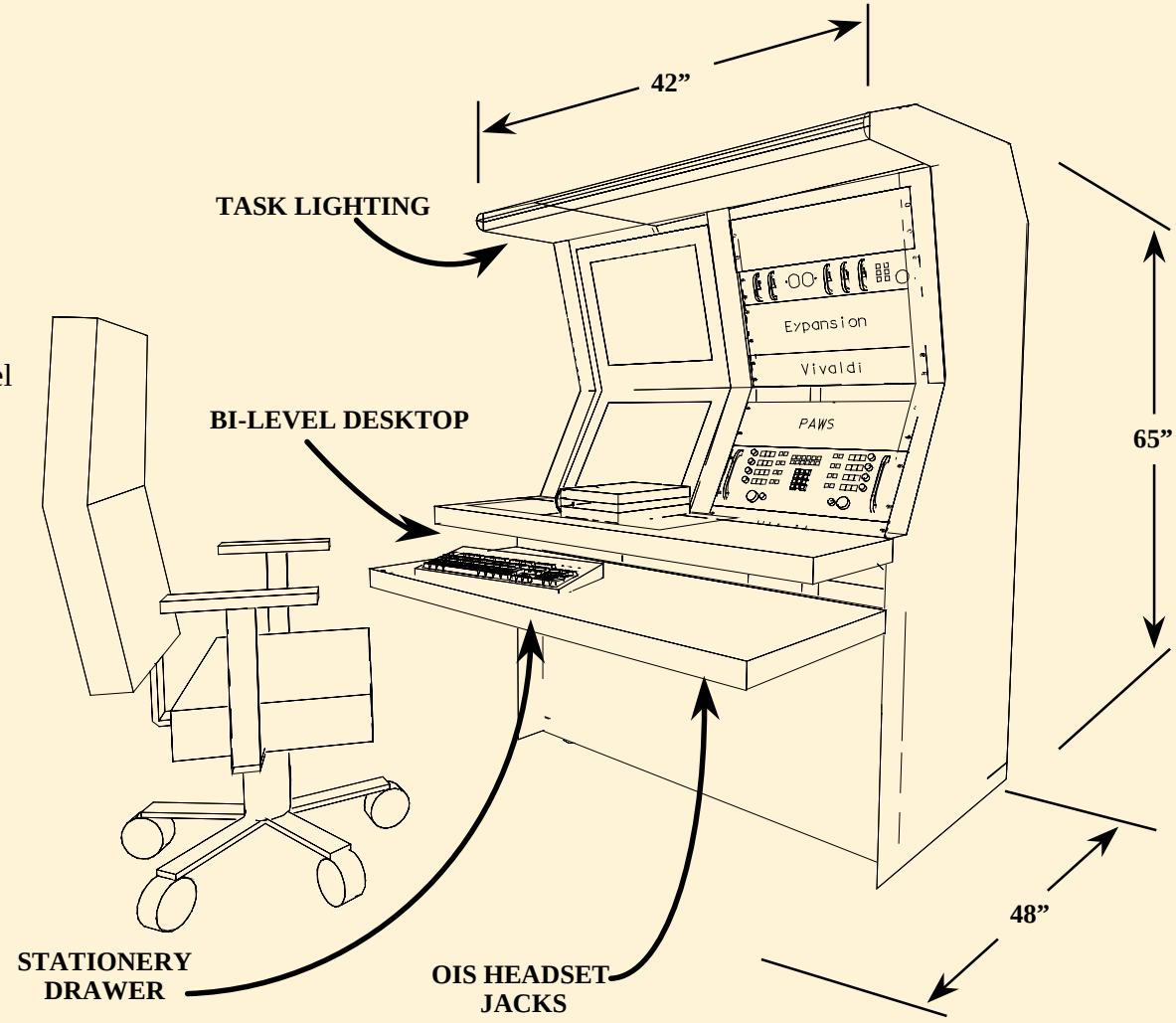
Conceptual Sketch

Workstations:
- BIN CPU with one Monitor
- OTV Monitor
- Basis/OTV CPU, if required

Visible Rack Equipment:
- OIS 51-D Unit
- Paging and Area Warning System Panel
- Utility Panel
- Expansion Area

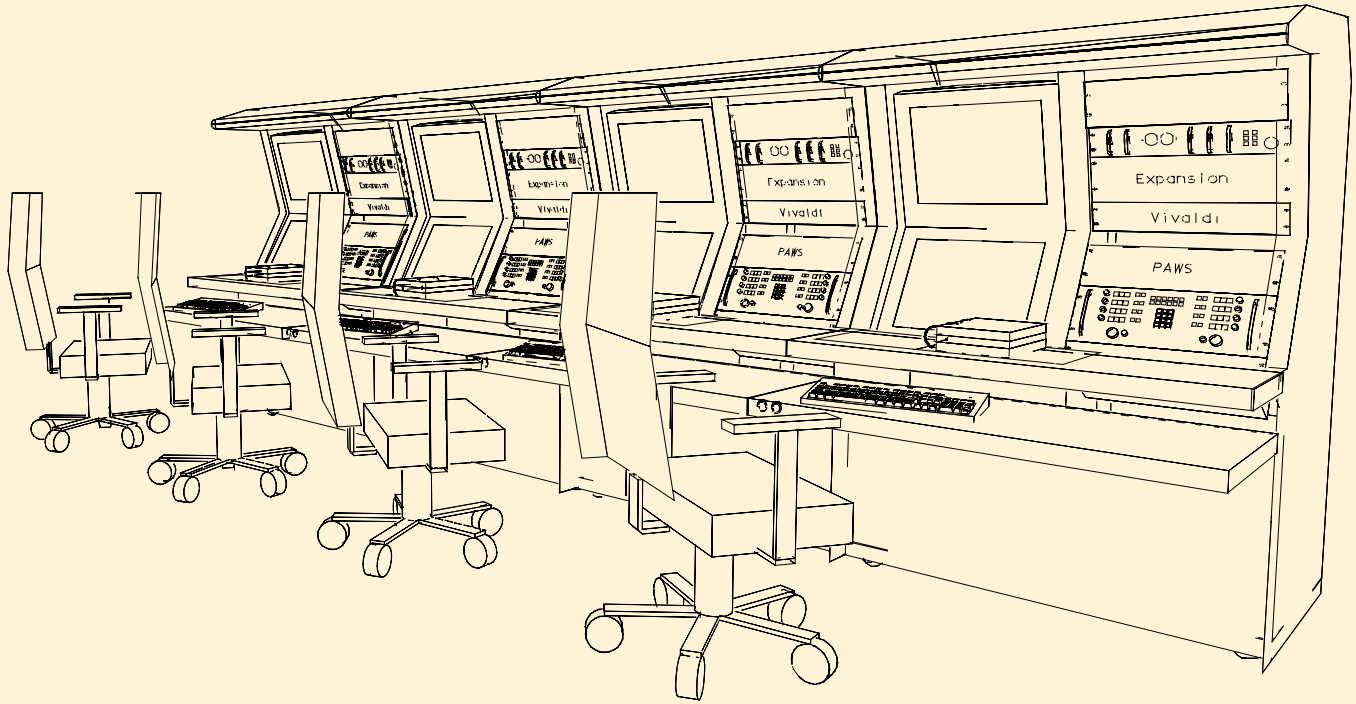
Hidden Rack Equipment:
- 2 Power Distribution Chassis
- Vivaldi (OTV) Unit
- Network Hub/Concentrator
- CLCS Port Panel

Other:
- 2 Internal Power Receptacle Strips
- 2 Telephones
- Placard Holder
- Beverage Receptacle
- Primary desktop height: 26” min.
- Primary desktop depth: 22” max.
- Secondary desktop height: 31” max.
- Secondary desktop depth: 13” max.



TC Console Enclosure Requirements (continued)

TC Area Grouping Conceptual Sketch



Console Support Module Requirements

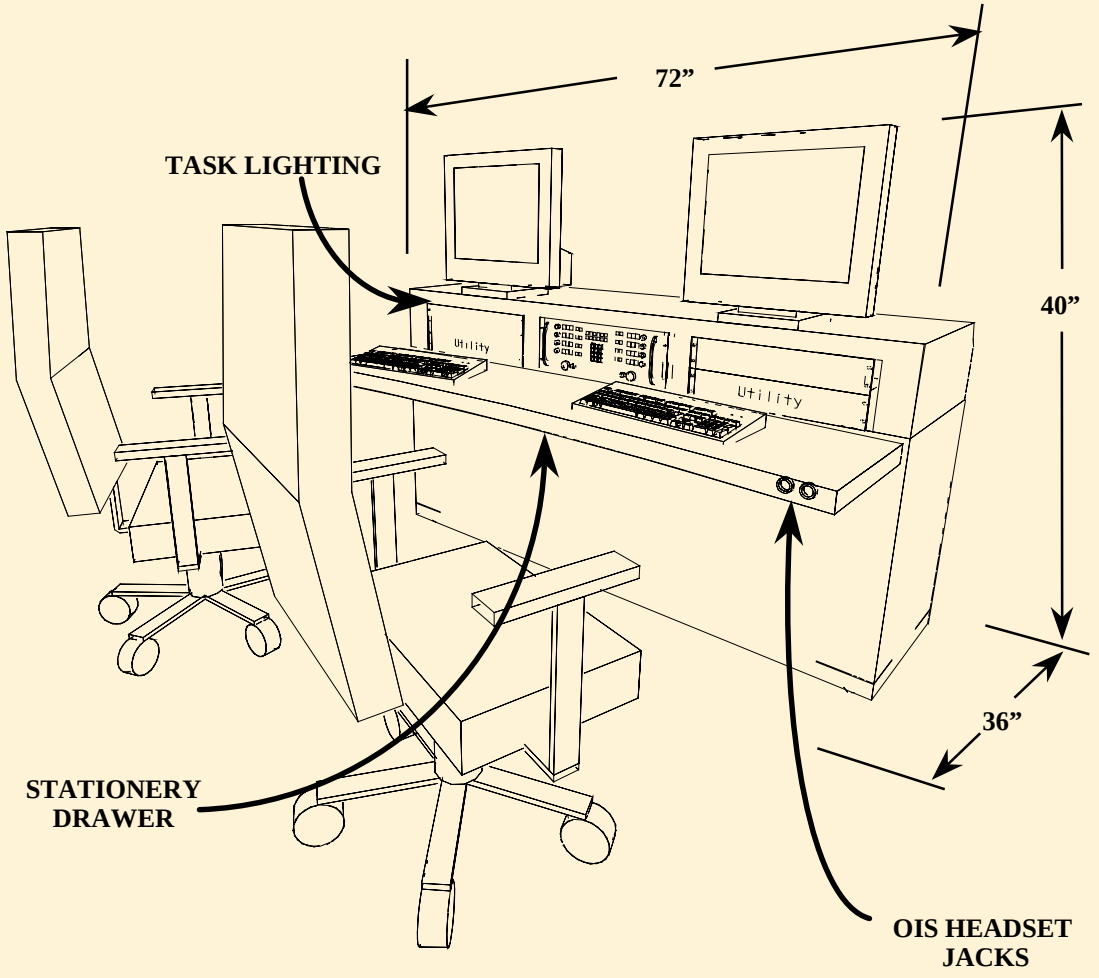
Conceptual Sketch

Workstations:
- Two Command & Control or BIN CPU's
- Two Flat-Panel Monitors

Visible Rack Equipment:
- OIS-D Unit
- Utility Panel(s)
- Expansion Area/Venting

Hidden Rack Equipment:
- 1 Power Distribution Chassis
- CLCS Port Panel
- Expansion Area/Venting

Other:
- 2 Internal Power Receptacle Strips
- 1 Telephone
- Beverage Receptacles
- Desktop height: 27" to 30"
- Desktop depth: 22" max.



MM Console Enclosure Requirements

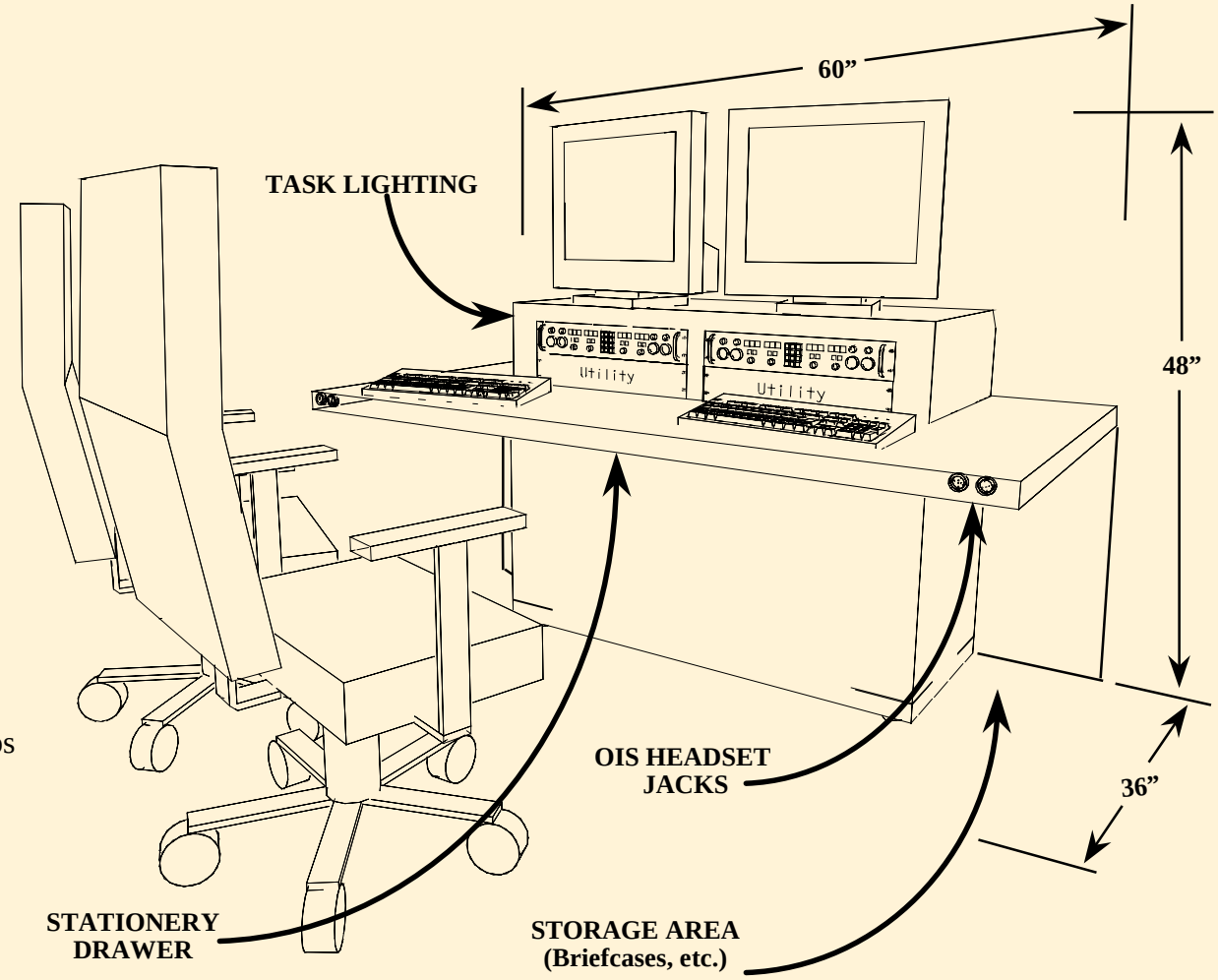
Conceptual Sketch

Workstations:
- Two BIN CPU's
- Two Flat-Panel Monitors

Visible Rack Equipment:
- 2 OIS 52-D Units
- Utility Panel(s)

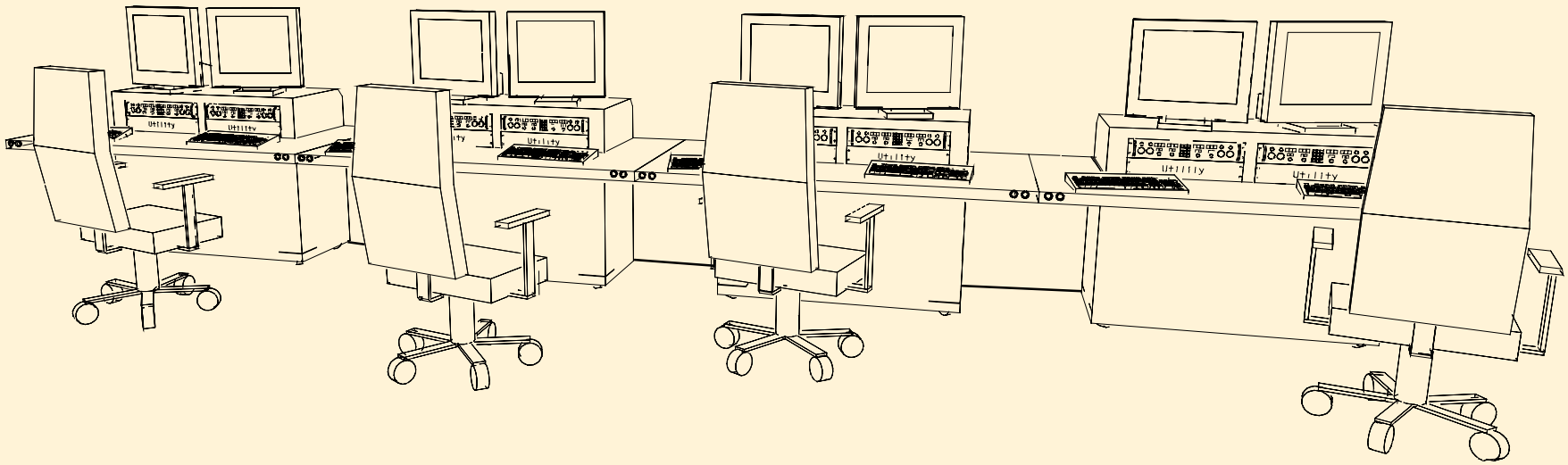
Hidden Rack Equipment:
- 1 Power Distribution Chassis
- CLCS Port Panel
- Expansion Area/Venting

Other:
- 2 Internal Power Receptacle Strips
- 2 Telephones
- Beverage Receptacles
- Desktop height: 27" to 30"
- Desktop depth: 22" max.



MM Console Enclosure Requirements (continued)

OMR/OSR Area Conceptual Sketch



Note: Normally, two users per console

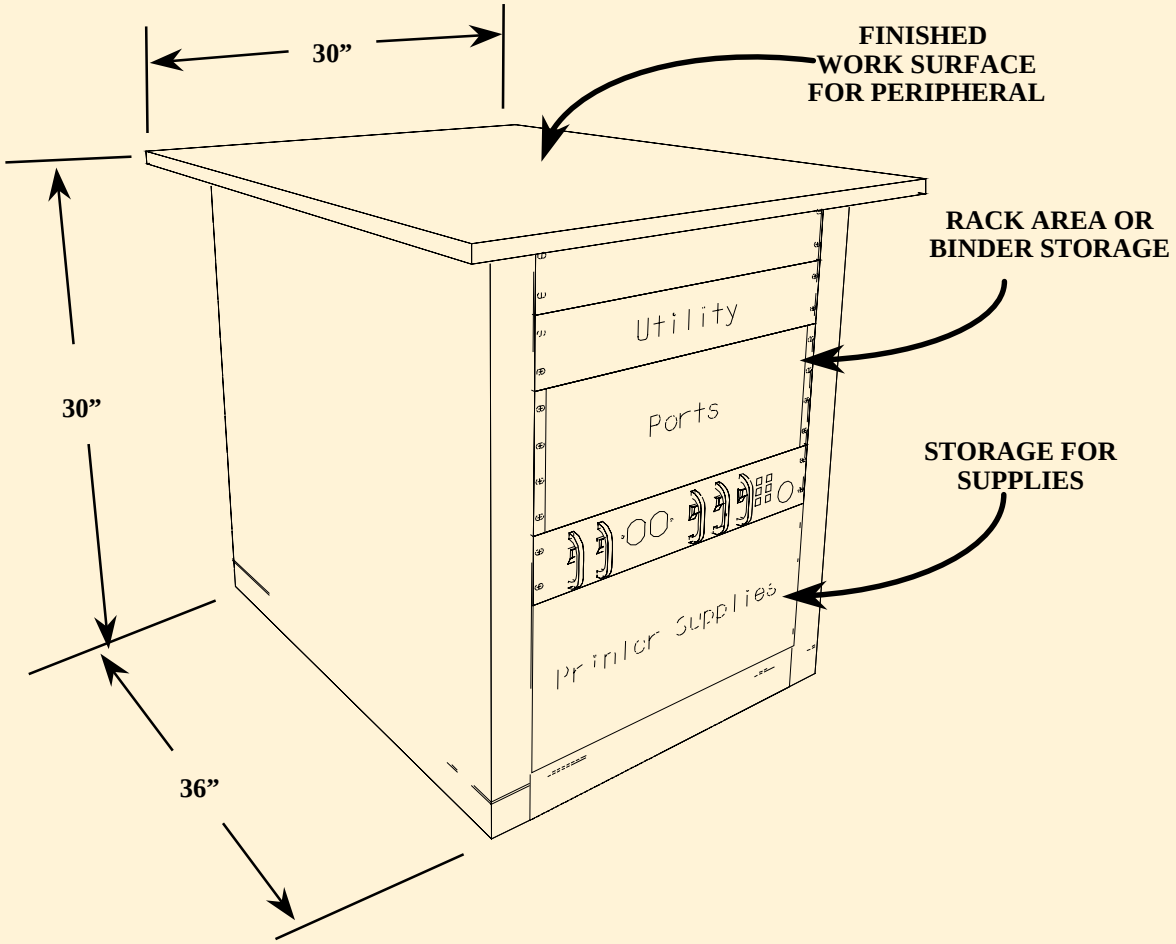
Peripheral Housing Requirements

Conceptual Sketch

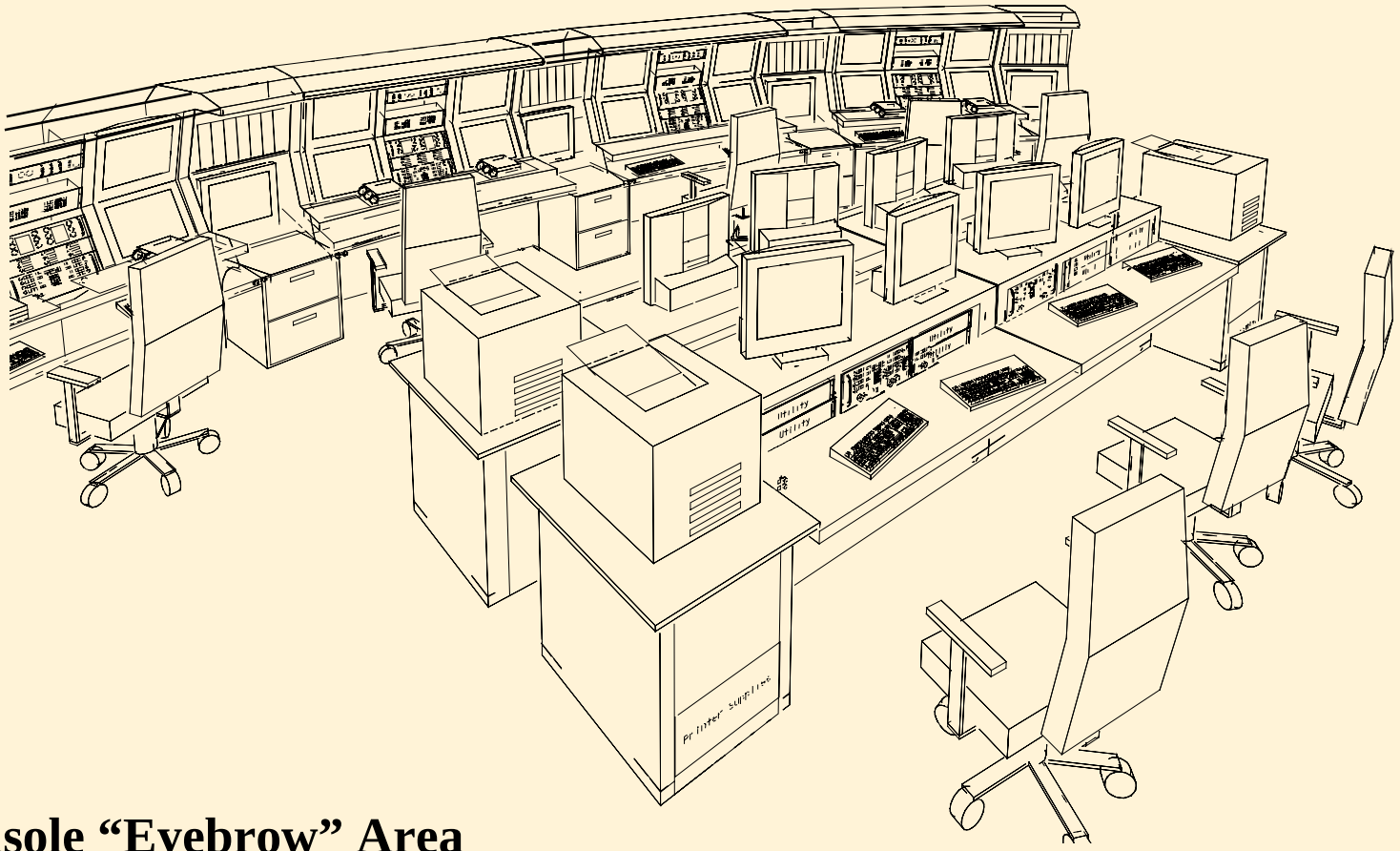
AC Power Converter Cords:
- 120V/15A Receptacle
- 120V/20A Receptacle
- 208V/15A Receptacle

Access to Rack Equipment:
- Power Distribution Chassis
- CLCS Port Panel
- Utility Panel

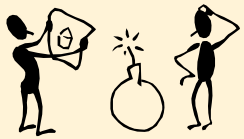
Sound Suppression Panel:
- Nominal dimensions: 60” tall x 30” wide x 2” thick
- Sound absorption fabric on the two sides of the panel
- Panel attached to either long side of the Peripheral Stand
- Capable of being removed without detracting from aesthetics of Peripheral Stand
- Note: Panel may be a separate furniture item



OCR Conceptual Sketch



Console “Eyebrow” Area



Presentation Outline

Build-to-Print vs. Build-to-Spec Acquisitions

- The Console Enclosures deployed in CLCS Flow Zones will be commercial products, built “off center” by a commercial vendor
- There are two major options to acquire commercial CLCS Console Enclosures
  - Build-to-Specification (vendor would likely be a commercial console enclosure manufacturer)
  - Build-to-Print (vendor could be a local machine shop or commercial console enclosure manufacturer)
- Informal LCC-X Feedback indicated that in-house console enclosures were of comparible quality to commercial console enclosures
- Both options will be utilized where feasible for Production CLCS Console Enclosures

Console Enclosure Acquisition Strategy (continued)

Build-to-Specification Acquisition Scenario

- **Advertisement and award of contract (Procurement preparation time, issue RFP, prepare contract - 45 days, minimum)**
- **Work with vendor design team to develop design/drawings (4-6 weeks)**
- **Meanwhile, vendor could be purchasing materials and parts**
- **Fabrication of first-article products (8 weeks)**
- **Approve first-article products and proceed with HMF/SAIL/OCR-1 console production**

Notes:

- **Schedule is extremely aggressive and optimistic**
- **No fabrication until at least February 1998**
- **Changes in requirements or design adds costs to remainder of contract**
- **Less control of fabrication and schedule for product delivery**

Console Enclosure Acquisition Strategy (continued)

Build-to-Print Acquisition Scenario

- Produce final design drawings (6-8 weeks)
- Purchase parts and materials for in-house fabrication and/or for GFE to on-board, outside, machine-and-fab shops (8 weeks), concurrently
- Fabricate first-article products, concurrently, in-house or onboard shop

After drawing release:

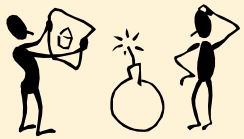
- Advertise and award contracts for additional first-article pieces to on-board shops
- Advertise and award contracts for fabrication of Thor production consoles (HMF/SAIL/OCR-1) to on-board shops or industry-wide

Notes:

- Schedule is flexible. Flexibility of incremental procurements using on-board shops - facilitates program requirement changes.
- Fabrication of first-article products can begin December 1997
- On-board shops can be contracted to do all or parts of first-article products
- Drawings revised in-house. Latest revisions would be issued with each console buy, thus keeping console constract costs minimized due to changes

Console Enclosures Acquisition Matrix

Type of Console Enclosure	Assembly Number	Acquisition Strategy	Design Performed By
CLCS System Engineering Console Enclosure	84K04506	Build-to-Print	NASA DP-3
CLCS Test Conductor Console Enclosure	84K04511	Build-to-Print	NASA DP-3
CLCS Console Support Module Enclosure	84K04516	Build-to-Print	NASA DP-3
CLCS Mission Management Console Enclosure	84K04521	Build-to-Spec	Enclosure Vendor
CLCS Peripheral Housing	84K04526	Build-to-Spec	Enclosure Vendor



Presentation Outline

Budgetary and Schedule Discussions

- **Enclosure Budget Phasing per Delivery (Estimated and Approximate):**

THOR	**= 2.0%**	**2 SE, 1 TC, 1 SM, 1 MM, 2 PS**
ATLAS	**= 16.5%**	**34 SE, 3 TC, 18 SM, 0 MM, 22 PS**
TITAN	**= 20.3%**	**29 SE, 17 TC, 11 SM, 18 MM, 11 PS**
SCOUT	**= 7.2%**	**14 SE, 2 TC, 5 SM, 0 MM, 5 PS**
DELTA	**= 10.5%**	**16 SE, 5 TC, 12 SM, 2 MM, 12 PS**
SATURN	**= 21.5%**	**36 SE, 15 TC, 12 SM, 18 MM, 16 PS**
NOVA	**= 22.0%**	**32 SE, 12 TC, 16 SM, 18 MM, 16 PS**
TOTAL	**= 100.0%**	**163 SE, 55 TC, 75 SM, 57 MM, 84 PS**